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Taking Stock of the Energy and Climate Profile of Germany and the USA: New Potential for Cooperation

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Abstract
Germany and the United States are both important players in international energy and climate policy. They are major international donors in the energy sector, they participate in manifold bi- and multilateral cooperation formats in the realm of energy and climate policy and they have historically both been leaders in clean energy technology development. Notwithstanding, they have very different starting conditions for and approaches to energy and climate policy. While the US is nearly energy independent, in Germany, the Russian war against the Ukraine has highlighted the high dependence on energy imports. Yet, Germany has experienced a strong increase in renewable energy production, fostered by strong state regulation, as it is an essential element of its climate policy. In the US, overall, renewable energy production has grown at a slower pace, also because climate policy has faced curvier roads through the past decades, and political conditions have changed often. This article seeks to take stock of where Germany and the US stand at this moment with their energy systems as well as their climate policies and examines common interests and cooperation potentials that can support sustainability transformations on both sides of the Atlantic.

Keywords Energy supply · Germany · USA · Climate policy · Transatlantic relations · Energy security

Eine Bestandsaufnahme des Energie- und Klimaprofils von Deutschland und den USA: Neue Potenziale für die Zusammenarbeit

Zusammenfassung
Deutschland und die Vereinigten Staaten sind beide wichtige Akteure in der internationalen Klimapolitik: Sie sind bedeutende internationale Geber im Energiesektor, sie beteiligen sich an vielfältigen bi- und multilateralen Kooperationsformaten im Bereich der Energie- und Klimapolitik und sind beide historisch führend in der Entwicklung sauberer Energietechnologien. Die beiden Länder haben jedoch sehr unterschiedliche Ausgangsbedingungen wie auch politische Regulierungsansätze für die Themen Energie und Klima. Während die USA nahezu energieautark sind, hat der russische Krieg in der Ukraine die starke deutsche Abhängigkeit von Energieimporten hervorgehoben. Nichtsdestotrotz hat Deutschland in den letzten Jahren einen besonders starken Zuwachs an erneuerbaren Energien erlebt, angeregt durch staatliche Regulierung, da erneuerbare Energien ein zentraler Bestandteil der Klimaschutzstrategie sind. In den USA ist der Zuwachs an erneuerbaren Energien gemäßigter, auch auf Grund dessen, dass der Klimaschutz hier in den letzten Jahrzehnten sehr stark wechselnden politischen Rahmenbedingungen ausgesetzt war. Mit diesem Artikel wird eine Bestandsaufnahme vorgelegt, wo Deutschland und die USA derzeit mit ihren Energiesystemen sowie ihrer Klimapolitik stehen. Ferner werden gemeinsame Interessen und Kooperationspotenziale identifiziert, die Nachhaltigkeitstransformationen auf beiden Seiten des Atlantiks unterstützen können.

Schlüsselwörter Energieversorgung · Deutschland · USA · Klimapolitik · Transatlantische Beziehungen

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1 Introduction

The world is facing a series of existential crises. The global threat of a warming climate stands at the center of these challenges. However, an intrinsic part of this is also what can be called an energy crisis. Not only must a clean energy supply take a key role in fighting climate change. Russia's war in Ukraine has put many countries, first and foremost in the EU, and especially Germany, in a position, where an energy transition and greater independence from energy imports, and a broader diversification of supplying countries have become a matter of security of energy supply and political and economic stability. The US, in contrast, is nearly energy independent: Through its vast fossil fuel resources, renewable and nuclear energy capacities, it is able to supply most of its own energy needs. Here, creating a clean energy supply is a political and economic challenge: Climate protection is not a shared goal among the Democratic and the Republican Parties. And many regions in the US rely on the production of fossil fuels for employment opportunities. With an increasing European demand for fossil fuel imports from the US triggered by the Ukraine crisis, the latter may become an even bigger challenge for US climate protection efforts.

Both, the US and Germany play a central role in global climate policy. Their success in decarbonizing their economies is of vital importance for the achievement of the targets set in forward in the Paris Agreement. The countries have close political ties which they are increasingly seeking to strengthen to support a global energy transition. At the same time, they have very different starting points in their quest for climate neutrality. Among the many differences: The US is one of the biggest fossil fuel producing countries while Germany is a resource poor, highly energy import dependent country.

The article is divided into three sections followed by a conclusion. Section two uses energy data to give an overview of the initial situation as well as similarities and differences between the energy supply in the USA and Germany. Section three outlines climate and clean energy policies in both countries, analyzing sources such as key decisions, political programs, and regulations on energy and climate policy from the German government and the EU as well as in the US. Section four finally takes a transatlantic focus. It introduces existing formats of transatlantic climate and energy cooperation and discusses further cooperation potential as well as grounds for conflict based on different climate and energy policy pathways on both sides of the Atlantic.

2 Energy Systems in Comparison in Germany and the USA

In Germany and the US, the overall context for climate policymaking differs substantially, as select indicators in Fig. 1 outline. These differences are closely connected to the major energy system differences which the following chapters discuss for both countries. Energy systems are an important starting point for an examination of climate policies, as greenhouse gas emissions are, to a large extent, energy-related and caused by the combustion of fossil fuels, for instance for transportation, electricity and heating (Umweltbundesamt 2022b).

2.1 The German Energy System: Resource Scarcity, Import Dependence and a Steep Increase in Renewables

Germany is a country relatively poor in energy resources. After the last hard coal mine was shut down at the end of 2018, lignite is the only significant domestic fossil energy source. It is legally stipulated, that coal will be phased out by the end of 2038 at the latest. In the future, no significant fossil fuel extraction will occur in Germany. Natural gas and oil can only be produced to a limited extent because of the small and continuing decline in resources.

Fig. 2 indicates the amount of primary energy consumption by energy source in Germany as well as the share of imports for each source. It underlines firstly, that Germany remains highly dependent on fossil fuels to cover primary energy consumption. Some 77% of Germany's primary energy consumption was fossil-fuel-based in 2021 (Arbeitsgemeinschaft Energiebilanzen e.V. 2021). Second, the figure shows Germany's strong import dependence on oil, natural gas and hard coal. The country currently covers 71% of its energy needs through imports. Germany's most important energy suppliers are Russia, Norway and the USA. The largest quantities of natural gas, crude oil and hard coal were imported from Russia in 2021 and the years before. Norway supplies natural gas and crude oil and the USA has also been an important supplier of oil and hard coal (Fig. 3).

In the power sector, Germany's dependence on conventional fuels has decreased markedly since the year 2000 as the installed capacity and share of renewables has increased. Germany has a total of 220 GW of capacity in the electricity market in its own country (Bundesnetzagentur 2022). Renewable energies, in particular wind and solar, account for 63% of this (as of 31 May 2022). Since the year 2000, the capacities of wind and solar systems for generating electricity have been greatly expanded. The capacity of all power generation systems based on renewable energies had increased more than tenfold by 2021. The total

Parameter	Unit	Germany	USA
Area in square kilometers	1,000 sg. km	357	9,832
Population (number)	million	83.2	331.9
Gross domestic product (GDP)	bn US$	4,219*	22,997
Primary energy consumption	Mtoe**	290	2,430
Import/Export balance on energy	bn US$	- 81	+ 20.5
Power generation (gross)	TWh	588	4,406
of that based on renewable energies (RE)	TWh	234	882
Share of RE in total power generation	%	40	20
Energy consumption per capita	toe	3.5	7.3
Power generation per capita	kWh	7,067	13,275

Fig. 1 Key energy indicators for Germany and the USA for 2021 (*3567 bn € (1.1827 US/€), **million tons of oil equivalent). (Source: Authors, based on World Bank (2022), U.S. Energy Information Administration (2022a) and Arbeitsgemeinschaft Energiebilanzen e.V. (2022))

installed renewables capacity is now almost twice as high as the maximum load of the German power system, which is approximately 85 GW. Nevertheless, due to their dependence on solar radiation and wind conditions, renewable energies have so far only been able to cover almost half of the total annual electricity demand. The volatility of electricity generation from sun and wind means that on some days renewable energies are able to cover most of the electricity demand in Germany: In sunny and windy hours, the total power generation is usually higher than the domestic power consumption. In such phases, Germany exports electricity to its neighboring countries. On the other hand, especially in winter, there are situations in which renewable energies only make a very small contribution to electricity generation. Therefore, wind and, in particular, solar energy have a smaller share in the amount of electricity generated than in the capacity of the electricity generation park. To make Germany independent of fossil fuels and guarantee a stable electricity supply, additional measures will become necessary. These include grid expansion, regulatory innovations, demand-side management, expansion of storage capacities and, in the longer term, clean hydrogen imports.

In 2021, renewable energy, mainly wind and solar, made up 39.7% in Germany's electricity generation mix. This is a decrease from the previous high of 45% in 2020. Coal (hard coal and lignite) supplied 28.1%, natural gas 15.2%,

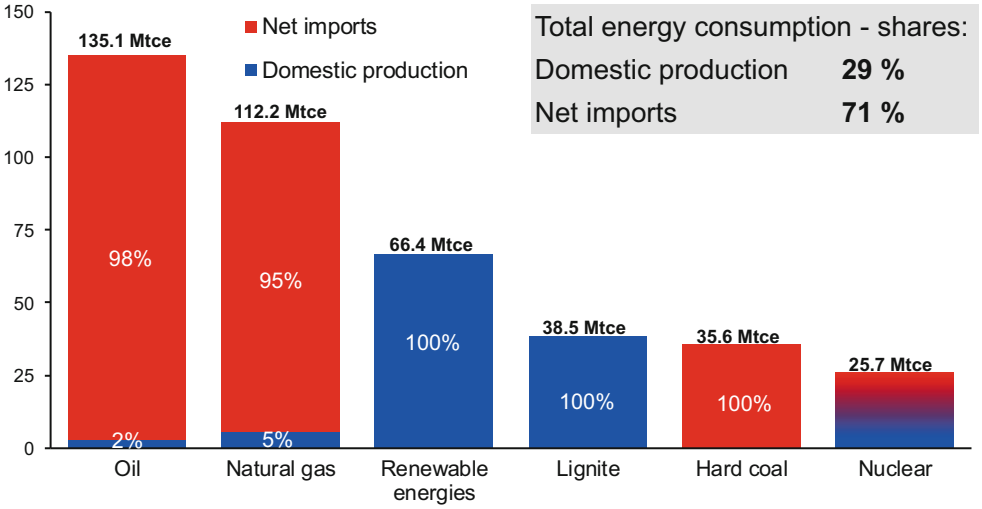

Fig. 2 Primary energy consumption and energy import dependence in Germany (Nuclear energy is shown in a mixed color because uranium has to be imported. In alignment with international practices. nuclear energy is usually classified as a domestic energy source from the point of security of supply.) (*Mtce* million tons of coal equivalent). (Source: Arbeitsgemeinschaft Energiebilanzen (2022); (the total consumption (including others with 5.0 Mtce) is 418.5 Mtce))

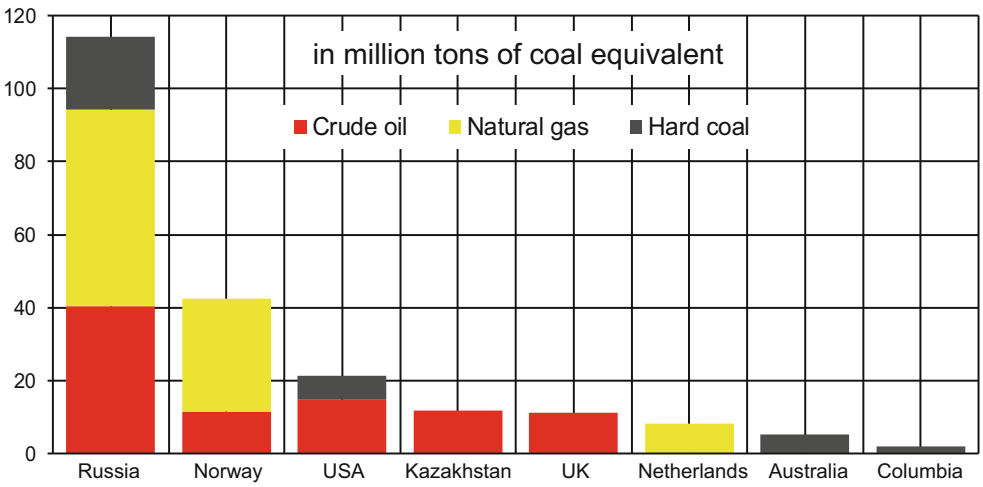

Fig. 3 Most important energy suppliers for Germany 2021. (Source Schiffer HW (2022))

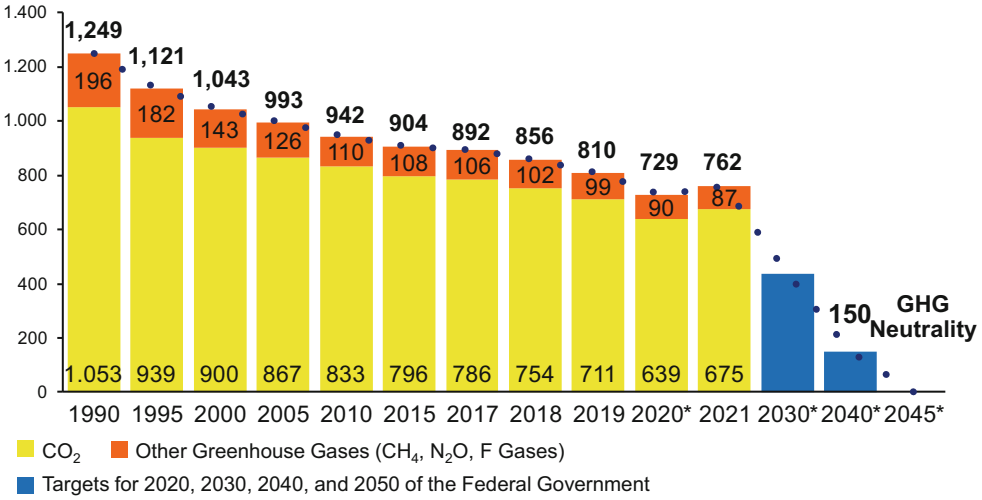

Fig. 4 Greenhouse gas emissions in Germany 1990–2021 and targets until 2045 (in million tons of CO_2 equivalents); Targeted objectives: Reduction of 40% by 2020, of 65% by 2030, of 88% by 2040, and greenhouse gas neutrality by 2045—in each case, compared to the status of 1990. (Sources: Umweltbundesamt (2022a, b))

oil 0.8% and other sources, such as pump storage and waste treatment, 4.4% in 2021. The share of nuclear energy was 11.8% (Arbeitsgemeinschaft Energiebilanzen e.V. n.d.). Germany is one of only a few countries lacking abundant hydropower resources that have such a high share of renewables in their generation mix. At 41.1%, the share of renewable energies in covering domestic electricity demand was slightly higher in 2021 than measured by generation. This is possible since in 2021 Germany was a net power exporter generating more electricity than consuming domestically. Exports of electricity to neighboring countries were greater than imports. In 2022, the contribution of renewable energies in covering domestic electricity demand is expected to exceed the 45% share achieved in 2020, a sharp increase compared to only 6% in 2000 and 17% in 2010.

Germany has the highest power prices worldwide (see below, Fig. 7). In addition to the prices for energy production and imports, a range of policy instruments, explained in more detail below, contribute to this. Among them are the recently abandoned surcharge (EEG-Umlage) under the German Renewable Energy Law (Erneuerbare Energien Gesetz, EEG), taxes and CO_2 pricing in Germany.

In 2021, primary energy consumption in Germany was 18% lower than in 1990, despite increased economic output. Primary energy consumption per unit of gross domestic product (price-adjusted) was around 44% lower in 2021 compared to 1990. In addition to the change in economic structure (reduced share of energy-intensive production in total economic output), the increase in energy efficiency is one of the main explanations for the decoupling of economic performance and energy consumption (Arbeitsgemeinschaft Energiebilanzen e.V. 2022).

Greenhouse gas emissions in Germany have fallen by 39% from 1249 million tons of CO_2 equivalent (million t CO_{2e}) in 1990 to 762 million t CO_{2e} in 2021. Of the 762 million t, 675 million t were attributable to CO_2 emissions and 87 million t CO_{2e} to other greenhouse gases such as methane (Fig. 4). The strongest reduction was achieved in the energy sector, which fell by 47% from 466 to 247 million t CO_{2e}. Strong reductions were also recorded in the building sector (–45%) and industry (–36%). In contrast, greenhouse gas emissions in the transport sector remained almost constant between 1990 and 2021 (Bundesregierung Deutschland 2022a).

2.2 The US Energy System: Resource Abundance and the Role of Clean Energy

In contrast to Germany, the US is a country rich in fossil fuel resources. Technological advancements in hydraulic fracturing ("fracking") and drilling have enabled the country to become the world's biggest producer of natural gas and crude oil (Statista 2022a; U.S. Energy Information Administration 2022f). The country's natural gas boom began in 2007 with natural gas production reaching a record high of 934 billion cubic meters in 2021 (Statista 2022b). The biggest producers are Texas and Pennsylvania. Crude oil production has been increasing in production since 2009, reaching a historic high in 2019 of 12.29 million barrels per day (2021: 11.19 million barrels per day) (U.S. Energy Information Administration 2022k). Among the biggest oil-producing states are Texas and North Dakota.

The US is practically self-sufficient when it comes to energy production. In 2019, energy production exceeded energy consumption for the first time since 1957. With fossil fuel exports constantly increasing over the past decade, the country became a net exporter of natural gas in 2017 and of petroleum in 2020 (U.S. Energy Information Administration 2022e). The overall value of exported energy products exceeded the value of imported energy products for the first time in 2020 (U.S. Energy Information Administration 2022a). The U.S. also ranks fourth (after Indonesia,

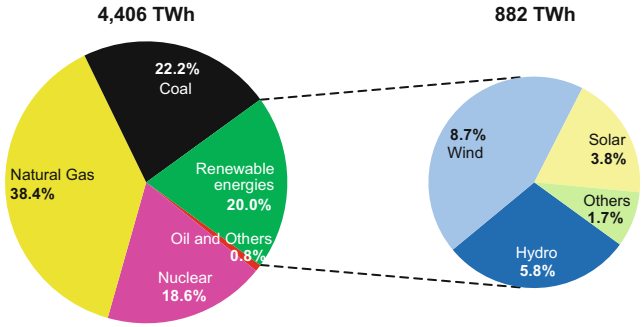

Fig. 5 Power generation mix of the USA in 2021. (Source Authors, based on BP 2022b)

Australia and Russia) in total coal exports worldwide. As in the other major exporting nations (except Australia), exports have, however, experienced a steep decline since 2018 (International Energy Agency 2021b).

Overall, the US remains highly dependent on fossil fuels for primary energy consumption (see Fig. 5). In 2021, the share of fossil fuels in primary energy consumption was at 79% (petroleum 36%, natural gas 32%, coal 11%) (U.S. Energy Information Administration 2022b). Coal is the only fossil fuel that has seen a steady decline in production and consumption since 2007 (except for the year 2021). The share of renewables in primary energy consumption has been growing only slowly in recent years and reached 12% in 2021, mainly due to increases in solar and wind energy capacity (U.S. Energy Information Administration 2022b, 2021a). In 2021, solar PV and onshore wind experienced record-breaking capacity growth—a trend the International Energy Agency expects to continue due to improving economics and conducive political conditions at the state and federal level (International Energy Agency 2021a, U.S. Energy Information Administration 2022a). On the production side, climate frontrunner state California is also a leader in solar PV. Texas is the leading wind energy producer and Iowa is the largest biofuel producer (U.S. Energy Information Administration n.d.).

Fossil fuels play an important role in the country's electricity mix, as well. Total generation capacity was close to 1200 GW in 2021. Fossil fuels assumed a share of 61% (U.S. Energy Information Administration 2022c). Natural gas has shown a particularly steep increase over the past two decades. It provides the most important source of electricity generation since 2016, assuming a share of 38% in 2021. Coal, in contrast, faced a steep decline between 2007 and 2020, followed by an increase in 2021. It is now the second most significant source of electricity generation (22%), but renewable energy is catching up quickly as a source of electricity generation. In 2020 its share surpassed coal for the first time and topped 20% in 2021. Renewable energy now has a share of 27% in utility-scale generation capacity (9% of this was hydroelectric) (BP 2022b). Iowa had the highest share of wind energy (at 57%) in its electricity mix in 2020. At 25%, California is the state with the highest share in solar energy in its electricity mix (U.S. Energy Information Administration n.d.). Nuclear power generation has remained relatively stable during the past decade as upgrades at existing facilities have offset the retirement of several reactors. Despite a slight increase in the capacity factor of the U.S. nuclear fleet in 2021, U.S. nuclear electricity (share in 2021: 18.5%) fell to its lowest level since 2012 (U.S. Energy Information Administration 2022c, 2021b, 2022d).

US electricity prices vary widely between the different US states. Lacking a centralized market, each states have different pricing schemes and requirements for renewable energy. States including California and New York have carbon-based marketing pricing for the electricity sector. California and eleven Northeast States take part in the Regional Greenhouse Gas Initiative (RGGI), which is the first mandatory cap-and-trade program in the US with the goal to limit CO_2 emissions from the electricity sector (Center for Climate and Energy Solutions). Retail electricity is the most expensive in Hawaii (39.97 cents per kWh) and cheapest in North Dakota (10.02 cents). On average, the retail price per kilowatt hour is 10.59 cents in the US (U.S. Energy Information Administration 2021c). Industrial electricity prices averaged 7.50 cents in 2021, but range from 26.27 cents in Hawaii to 3.87 cents in Oklahoma (U.S. Energy Information Administration 2022j).

The US is also among the largest energy consumers worldwide. In 2021 both US energy and electricity consumption (per capita) were approximately twice as high as in Germany (Arbeitsgemeinschaft Energiebilanzen e.V. 2022; U.S. Energy Information Administration 2022a). Primary energy consumption continued its rising trend during the Trump presidency until the onset of the Covid-19 pandemic, which dampened economic activity and energy consumption. In 2018, the country reached a new record high with energy consumption at 101.2 quadrillion British thermal units (Btu).

From a climate protection perspective, the energy system of the US remains highly emission intensive, despite the growth progress in renewable energy, especially in the electricity sector. CO_2 emissions from energy consumption were reported at 4870 million tons in 2021 (U.S. Energy Information Administration 2022a). In 2020, the US experienced a temporary COVID-19-related reduction in emissions, but emissions picked up again in all sectors in 2021, putting the US at roughly 19% below 2005 levels, which accounted for 6007 million tons, in 2021 (Fig. 6).

Per capita CO_2 emissions from energy consumption in the U.S were 14.7 tons in 2021 compared to 8.1 tons in Germany (Rivera et al. 2022; Umweltbundesamt 2022a). The rising share of renewables in the electricity mix in conjunc-

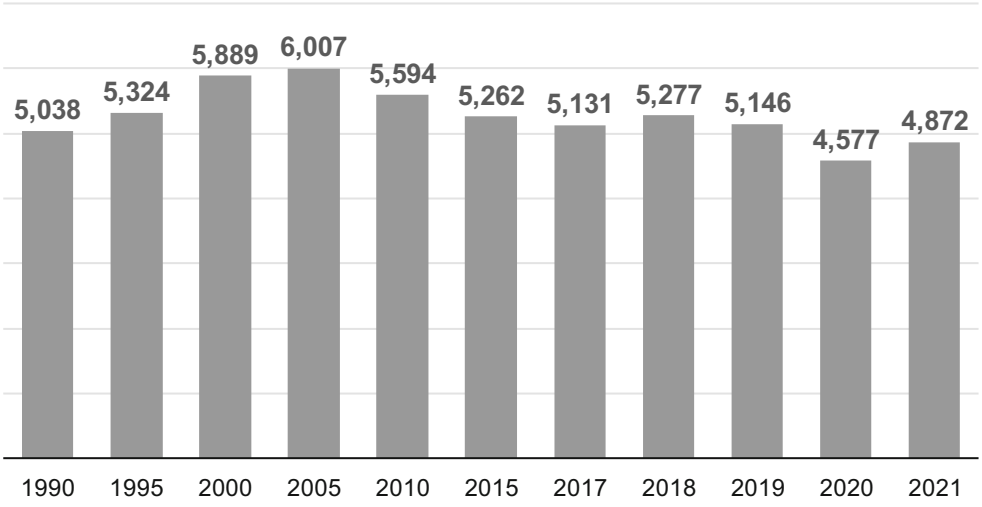

Fig. 6 Carbon dioxide emissions from energy consumption in the USA 1990–2021 (in million metric tons). (Source: U.S. Energy Information Administration (2022a))

tion with the ongoing fuel switch from coal to natural gas, resulted in quickly reducing CO_2 emissions in the electricity sector. In the transport and industrial sectors—the other major sources of emissions in the US, there is no similar emission reduction trend (U.S. Energy Information Administration 2022g). The US is experiencing a boom in renewables, besides an even greater boom in oil and gas production. Fossil fuel exports are increasing rapidly, shifting emissions from the US itself to other countries via energy exports (U.S. Energy Information Administration 2022a).

2.3 German and US Energy Systems in Comparison

Overall, the energy systems in Germany and the US vary substantially. Both countries are still highly dependent on fossil fuels. The US is experiencing a continued fossil fuel boom in production and exports, while Germany has experienced a renewables boom which largely benefits its electricity mix.

In contrast to the US, Germany depends on imports for almost all of the fossil fuels it consumes. The US, in contrast, is a net exporter of fossil fuels, which includes exports of oil, coal, and, since 2022, liquefied natural gas (LNG) to Germany. While Germany depends on fossil fuels for 77% of its primary energy consumption, in the US 81% of primary energy consumption is covered by fossil fuels.

The contrast in the two countries is far larger when analyzing the power sector. First, natural gas has more than twice as high a share in the US as in Germany. Second, in 2021, the contribution of nuclear energy in Germany was already significantly lower than in the USA, and by the end of 2022, nuclear energy is scheduled to be completely phased out in Germany.[1] Third, the share of renewable energies in total electricity generation was almost 40% in Germany in 2021, nearly twice as high as in the US. Renewables are a success story in the German electricity mix, more so than in the USA. In terms of total electricity generation capacity globally, based on renewable energies, the USA ranks second and Germany fifth (International Renewable Energy Agency 2022). In the US, renewable energy generating capacity, including hydro, has a much lower share of total electricity generating capacity than in Germany. And while electricity prices are high in Germany, they are low on average for U.S. consumers (Fig. 7).

CO_2 emissions have fallen in both countries, in Germany and the USA since 1990—in contrast to the global situation. Global CO_2 emissions from energy consumption have increased by 50% between 1990 and 2021. In the USA, on the other hand, there was a decrease of 3% (U.S. Energy Information Administration 2022a) and in Germany of 36% (Umweltbundesamt 2022a). In Germany, the decline was favored by the reunification effect, which led to a considerable reduction in CO_2 emissions, especially in the 1990s due to factors such as the reduction in lignite production in Eastern Germany and the closure of emission-intensive industrial clusters. In the USA, the decline started around 2005—primarily as a result of the replacement of coal with natural gas and the expansion of renewable energies.

3 Energy and Climate Policy in Germany and the USA

The energy systems analysis above underlines the challenges Germany and the US face in the race towards the international target of economy-wide net-zero emissions by 2050. A phase-out of fossil fuels is underway in both countries' electricity sectors but is much more advanced in Germany. For the other sectors (industry, transport, heat-

[1] With the exception of two power plant blocks in southern Germany, which are to be kept operational as a reserve until April 2023.

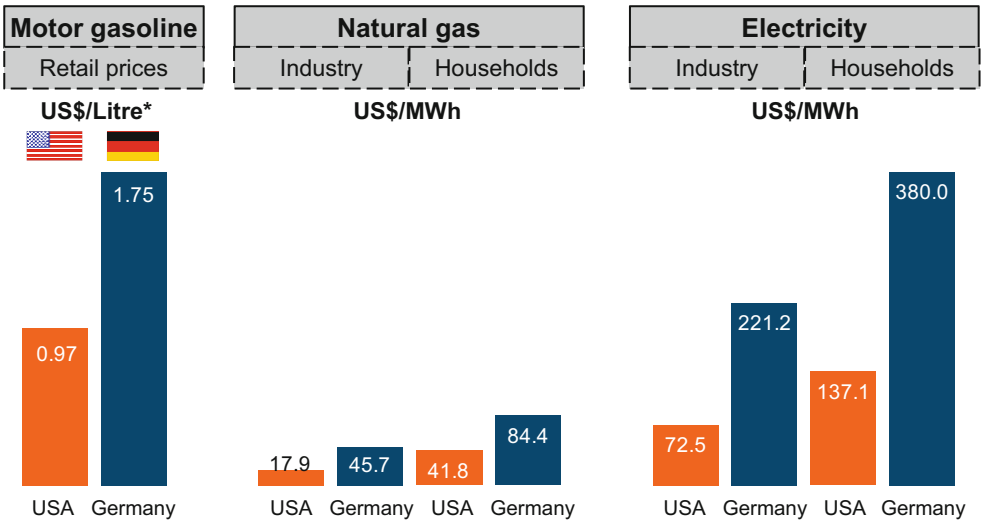

Fig. 7 Energy consumer price comparison 2021 between Germany and the USA. (*1 Litre = 0.2641722 gallons). (Source: EIA, Energy Prices, Paris 2022)

Characteristics	USA	Germany
Import dependency	Energy self-sufficient	High dependence on imports of oil, natural gas and coal
Governance	Strong role of states in energy policy making and as climate policy laboratories	Federal level and the EU are central, but also states are active
Energy policy Credo	America First	Energy transition to net-zero
Energy policy targets	Energy independence, climate policy as a motor for job creation and technology leadership	Climate protection as a target in itself; expansion to 100 % renewables, phase-out of nuclear energy and coal in power generation
Regulation	Regulatory measures at the state level play an important stabilizing role vis a vis shifting political interests at the federal level	The liberalization since the end of the 1990s to improve competitiveness was followed by increased regulation to comply with ambitious climate protection goals
Mitigation of CO_2-Emissions	Mix of air pollution regulation, market factors and technology advancement driving replacement of coal with natural gas; expansion of renewable energies	Government driven, among other things through strong support for renewable energy, energy efficiency and ramp-up of green hydrogen
Technology	Extensive technology neutrality with the inclusion of nuclear energy and carbon capture and usage/storage	Phase out of nuclear energy by the end of 2022, exclusion of carbon capture and storage in power plants as well as phase-out of coal by 2038 at the latest.

Fig. 8 USA and Germany—Select context factors for climate policy making. (Source Authors)

ing, agriculture), dependence on fossil fuels remains high and emission reduction success is low in both countries. In Germany, fossil fuel import dependence and high energy prices add to the complexity of designing an ambitious climate policy. The following review of recent climate and energy policies and some of their structural determinants in Germany and the US rounds off the energy system analysis (Fig. 8).

3.1 Germany's Strategy for Achieving Energy and Climate Objectives

In Germany, national and EU-wide targets provide the guiding framework for climate and energy policy measures. Also, measures on the subnational and local role add to the climate policy mix. Climate protection and the need for a sustainable energy transition have been a broad consensus in German society and among most major political parties for many years.

For more than two decades, the Renewable Energy Law (Erneuerbare Energien Gesetz, EEG) was the main governance scheme driving renewable energy capacity development for the power sector. It ensured significant financial support for renewable energy expansion through the EEG-surcharge and a priority feed-in for electricity from renewable energies. Electricity consumers paid the EEG surcharge as part of their electricity bills to financially support renewable energy expansion. Surcharges for energy-intensive industries were lower. The German government abandoned the EEG-surcharge in July 2022 given the

high current electricity prices (Bundesnetzagentur n.d.). It is estimated that electricity consumers paid around 263 billion € (300 billion US dollars) over the past two decades (2000–2021) in support of renewable energies for power generation in Germany.

Today, the core piece of climate legislation is the Climate Protection Act, last updated in 2021. It enshrines policy targets and sets the general directions for climate policy measures. It stipulates that climate, energy and economic policies are to be aligned with the Paris Agreement's goal of maintaining global warming at 1.5 °C. To this end, the aim is to reduce greenhouse gas emissions in Germany by 65% by 2030 and by 88% by 2040 compared to 1990 levels (Fig. 4). The goal is to achieve climate neutrality by 2045. The law furthermore contains annual GHG reduction targets for all sectors, such as energy, industry, transport, buildings and agriculture. For the energy sector, the target for 2030 is 108 million tons of CO_{2e} compared to 247 million tons of CO_{2e} in 2021 and 466 million tons of CO_{2e} in 1990 (Bundesregierung Deutschland 2022).

Climate and energy policy is implemented through a large mix of instruments that aim at reducing GHG emissions and boosting renewable energies. An important tool is the EU-wide greenhouse gas emissions trading system (EU ETS) that was introduced in 2005. It covers the energy sector and energy-intensive industries, as well as aviation. The continuous decline of the ETS GHG emissions cap has led to rising carbon prices (>80 € per t CO_2 in June 2022). In addition to the EU ETS, a national carbon pricing system for heating and transport started in Germany in 2021. This instrument obligates fuel distributors to acquire pollution rights in the form of certificates (upstream emissions trading). They, therefore, pay for the emissions that result from the subsequent burning of the fuels, such as petrol, diesel, light heating oil, liquefied gas, natural gas and from 2023 onwards also coal (Deutsche Emissionshandelsstelle (2021)). The annually increasing CO_2 price started at 25 € per ton in 2021, and from 2026 onwards, carbon permits will be auctioned and the price created freely on the market.

3.1.1 Goals and Measures of the Current Governing Coalition in Germany

Since December 2021, Germany has been governed by a coalition between the Social Democratic Party (SPD), the Greens and the Liberal Party (FDP). The new government aims to achieve climate targets through national measures and international cooperation. Domestically, the government has set a very strong focus on the expansion of renewable energies and their establishment as the basis of energy supply in Germany in the future, an objective already pointed out in the government's coalition treaty.

Soon after the new government entered office, two developments influenced the chosen course of climate and energy policy. First, by the end of 2021, the new Minister for Economic Affairs and Climate Action (BMWK), Robert Habeck released studies that through a sector-by-sector gap analysis showed that 2022 emissions would be above the desired trajectory and that the current 65% GHG emission reduction target for 2030 could be missed (Federal Ministry for Economic Affairs and Climate Action 2022a). Second, the war of aggression against Ukraine initiated by Russia in February 2022 made a modification of German energy policy necessary. Next to climate protection aspects, energy supply security and prices as well as maintaining the international industrial competitiveness have come to dominate political discourse.

To address these challenges, the government introduced several bundles of measures which are summarized below: The Klimaschutz-Sofortprogramm of January 2022; the measures to reduce dependence on Russia from March 2022 (Federal Ministry for Economic Affairs and Climate Action 2022b) and the Easter Package of April 2022 (Federal Ministry for Economic Affairs and Climate Action 2022c), which is currently going through the legislative process.

Comprehensive measures will be taken to drive the expansion of renewables. In 2030, 80% of Germany's expected gross electricity consumption of 680–750 TWh is to come from renewable energies. To reach this, photovoltaics are to be expanded to approximately 200 GW by 2030 with 2% of the state's land is to be designated for the use of wind energy. The capacity for offshore wind turbines is to be increased to at least 30 GW by 2030, 40 GW by 2035 and 70 GW by 2045. The expansion of offshore wind energy will be based on the invitation of bids for sites that have already been investigated. In the future, bids will also be invited for sites that have not been subject to a preliminary investigation. Overall, rules for renewable energy planning and construction will be simplified, and, approval procedures streamlined. The participation of municipalities in onshore wind and photovoltaics will be extended, more low-wind sites will be developed, and the policy environment for the expansion of roof-top PV installations will be improved. The rights of the end-users and the supervisory powers of the Bundesnetzagentur (Federal Network Agency) over energy suppliers will be strengthened to provide improved protection to electricity and gas consumers. In addition, the government aims for a 20–25% drop in final energy demand, and the aforementioned acceleration of coal power generation phase-out. Originally, it was scheduled to occur until 2038 at the latest, but now would ideally be completed by 2030.

For the heat supply, a very high share of renewable energies and a 50% share of climate-neutral heat by 2030 are

targeted. A comprehensive use of electricity generated with renewable energies for sector coupling is to be ensured, i.e. for the heat supply of buildings and the provision of electricity for the transport sector. A Solar Acceleration Package mandates all new commercial premises (and in the future, residential buildings) be fitted with solar panels. Additional measures are planned for the heating sector, such as a quota of 65% renewable energy for newly installed heating systems.

In the transport sector, Germany aims at becoming the leading market for electromobility. At least 15 million electric cars will/ are planned to be on the road in Germany by 2030. By 2035 at the latest, all new vehicle registrations are to be exclusively CO_2-neutral vehicles.

Finally, a focus is set on the creation of a market for hydrogen. In 2022, the hydrogen strategy adopted in 2020 is to be updated with the goal of a rapid market ramp-up. The German government is focusing on green hydrogen and aims to build around 10 GW of electrolysis capacity by 2030. In addition, the import and transport infrastructure necessary for the use of hydrogen is to be advanced.

Until renewable energy sources can fully meet the demand, gas functions as a temporary solution. Therefore, the construction of "hydrogen-ready"-gas-fired power plants is also planned. In response to the energy crisis caused by Russia's war in the Ukraine, the government also proposed the construction of three floating LNG terminals via the companies RWE and Uniper, with the first terminals scheduled to be operational by the winter of 2022/23. Other LNG terminals, such as the Brunsbüttel terminal with a capacity of 8 billion cubic meters, are in the planning process and scheduled to be ready for supply in 2026.

The new strategy is not only to bring Germany on the path towards achieving its climate targets but also to become the leading green location for industry. In this context, further laws, regulations and other measures for implementation can be expected during 2022. With its energy policy measures, the German government is also seeking to rapidly reduce the dependence on Russian energy and broaden its supply base of the energy used in the country. One central building block in the efforts to reduce the dependence on Russia is to consume far less oil and gas, both directly (especially in heating, transport and in production processes) and indirectly (through the electrification of processes which have so far used oil and gas). Securing German gas supply has proven a considerable challenge for the government. As BMWK's Second Energy Progress Report indicates, in 2021, Russian imports accounted for 55% of the market. This dropped to around 35% by mid-April 2022. The target is to gradually reduce the volume of Russian gas until it covers only 10% of gas consumption in mid-2024.

3.1.2 EU Energy and Climate Policy: The Fit-for-55 Package

For the future orientation of German climate and energy policy, it is not only national requirements that are decisive. The rules of the European Union (EU) play an increasingly important role. The EU adopted a new overall strategy, the European Green Deal. Under the umbrella of the Green Deal, in 2021 EU member states agreed on a the new GHG reduction target for the year 2030 with a 55% reduction compared to 1990. The new requirement became legally binding with the European Climate Law in July 2021. The targets will be put into practice through the "Fit-for-55-Package". With the legislative proposals, the Commission presented the envisioned legal instruments for the realization of the objectives agreed upon in the European Climate Law (Council of the European Union 2022). They combine several measures including stronger requirements for and the inclusion of new sectors (transport and heating) into the EU ETS; increased use of renewables; increased energy efficiency; a faster introduction of low-emission transport modes and of the requisite infrastructure and fuels; an alignment of the fiscal policy to the objectives of the European Green Deal; measures to prevent carbon leakage; and instruments for the preservation and expansion of the natural CO_2 sinkholes. Furthermore, a tax that covers GHG emissions of goods imported into the EU (Carbon Border Adjustment Mechanism (CBAM)) is to be implemented to support the EU ETS. If finalized, this measure would replace the existing practice of cost-free allocation of CO_2 allowances for energy intensive industries under the ETS.

Moreover, the Commission proposes to tighten GHG reduction requirements for those sectors that are not covered by the EU ETS such as heat, transportation and agriculture. The Commission proposed to lift emission targets for these non-ETS sectors from 30–40% by 2030 when compared to 2005. And while the EU ETS only includes an EU-wide reduction target, the non-ETS sectors are governed through the so-called EU Effort Sharing Regulation which sets individual national targets. Germany's obligation to reduce CO_2 emissions in these sectors has so far amounted to minus 38% by 2030 when compared to 2005. Under the EU Effort Sharing Regulation (European Commission 2021a), new and stricter emission reduction targets for buildings, transportation, agriculture, waste management, and small enterprises have been assigned to the member states—for Germany, the rate stands at a reduction of 50% by 2030 when compared to 2005 (Fig. 9).

For the supply of fuels in road transport and the building sector, a new emission trading system will be introduced in 2026 (European Commission 2021b).

In May 2022, the European Commission presented the REPowerEUPlan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition (European

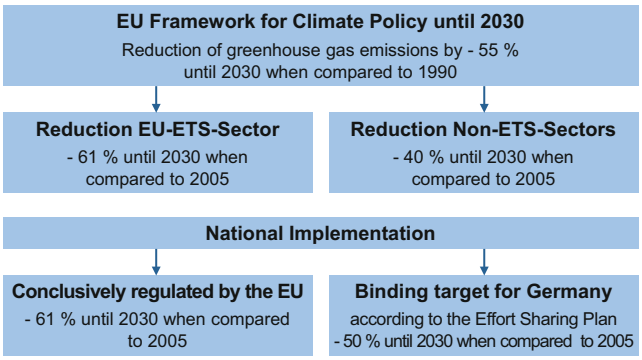

Fig. 9 Binding climate targets by 2030 in line with the Fit-for-55 Package of the EU-27

Commission 2022c). The measures in the REPowerEU Plan target energy savings, diversification of energy supplies, and an accelerated roll-out of renewable energy to replace fossil fuels in homes, industry and power generation, as well as increased hydrogen production based on renewable energies (Fig. 10).

3.2 Recent Climate and Energy Policy Developments in the US

Climate and sustainable energy policies have faced bumpy roads in the US in the past. This is due to a mix of factors that shape climate policy, including (party) politics, the political system, public opinion and the power and composition of interest groups in the US.

3.2.1 Federal Climate and Energy Policy Making

To a strong extent, US presidents determine the general direction and priorities for climate action at the national and international scale. After four years of climate policy inactivity under the Trump Administration, President Joe Biden declared climate policy to be a focal topic of his presidency in 2021. He has been giving new impulses for climate protection and has also made a spirited return to international climate engagement when he rejoined the Paris Agreement on his first day in office.

In the US, climate targets are not enshrined in a central climate law. What sets the framework is a set of executive commitments and executive orders. The Bipartisan Infrastructure Investment and Jobs Act as well as the recently adopted Inflation Reduction Act (discussed further below) provide financial incentives for climate-friendly technologies and infrastructures. In April 2021, President Biden announced the new U.S. climate target of reducing GHG emissions by 50–52% below 2005 levels by 2030. The new *Nationally Determined Contribution* (NDC) under the Paris Agreement sets the goal of achieving economy-wide net-zero emissions no later than 2050. In November 2021, the Biden Administration released a long-term strategy and roadmap how to achieve this target. The first climate-related executive order the Biden Administration issued was titled *Tackling the Climate Crisis at Home and Abroad*. It contains many of the Administration's targets and guidelines. For instance, Biden announced the goal of achieving a carbon pollution-free electricity supply in the US by 2035. This is to be achieved by increasing renewable energy capacities, through nuclear energy, batteries as well as 'clean' fossil fuel energy production (fossil fuels in combination with CCS). In this context, the Administration also announced the target of achieving an installed capacity of 30 Gigawatt of offshore wind by 2030 (The White House 2021b). The executive order also establishes that 40% of federal climate-related investments should benefit disadvantaged communities.

One focal point of Biden's climate agenda is the transportation sector which produces the biggest share of US emissions. Biden has set the target of increasing the share of zero-emission-vehicle (ZEV) in overall automobile sales in the US to 50% by 2030. In December 2021, Biden issued the Executive Order *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability* and the accom-

Fig. 10 REPower EU: Key points of a plan presented by the European Commission to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition

- Tightening of the binding **Energy Efficiency Target** – specified as part of the *Fit for 55* package of European Green Deal legislation with a 9% reduction in energy consumption by 2030 compared to 2020 – to 13%
- Development of a ***joint purchasing mechanism*** for gas and hydrogen
- Proposal to increase the **headline 2030 target for renewables** – specified under the *Fit for 55* package with a share of 40% in total energy consumption – to 45%
- A dedicated **EU Solar Strategy** to double solar photovoltaic capacity by 2025 and install 600 GW by 2030
- A **Solar Rooftop Initiative** with a phased-in legal obligation to install solar panels on new public and commercial buildings and new residential buildings
- **Doubling of the rate of deployment of heat pumps** and measures to integrate geothermal and solar thermal energy in modernised district and communal heating systems
- Recommendation to **shorten and simplify permitting processes** for large projects in the field of renewable energies
- **Setting a target of 10 million tonnes of domestic renewable hydrogen production** and 10 million tonnes of imports by 2030, to replace natural gas, coal and oil in hard-to-decarbonise industries and transport sectors
- A **Biomethane Action Plan** to increase production to 35 bcm by 2030
- Roll out of **carbon contracts for difference** to support the uptake of green hydrogen by industry

panying Comprehensive *Sustainability Plan for the Federal Government* (The White House 2021a). It places particular importance on the role of public procurement in spurring private sector investment in clean technologies and products and supporting the market for clean electricity and electric vehicles. By 2035, according to the Sustainability Plan, the federal government aims to procure 100% ZEV for its new vehicle acquisitions. Public procurement is also a key instrument for power supply decarbonization. The Sustainability Plan requires U.S. government agencies and departments to obtain 100% of their electricity from clean (carbon pollution free) sources by 2030.

In his policy approach, Biden combines climate policy with issues of environmental justice and job creation. With his executive order *Ensuring the Future is Made in All of America by All of America's Workers,* as well as in a regulation updating the *Buy American Act* requirements, the Biden Administration sets a focus on domestic production. These policies gradually increase the '*Made in America*' requirements from the current 55% to 75% by 2029 for products purchased by the federal government. The goal is to create jobs and improve environmental justice as well. They ensure that the American labor force, including disadvantaged groups and small- and medium sized U.S. manufacturers, benefit from the government's climate-friendly public procurement guidelines.

Next to activities by the US executive, the other central determinant and often a climate policy obstacle in US politics is a climate skeptic Congress. Biden originally sought to incorporate much of his climate protection agenda into bipartisan legislation in his first year in office. Congress, however, blocked several important proposals for climate protection and energy transformation. Achieving bipartisan agreement on climate measures has proven very difficult and even within Biden's Democratic party, there is no consensus on climate policy. The required bipartisan majority of 60 Senators for the passing of most legislative bills already prevented several attempts at climate legislation in the past (Drennen and Hardin 2021).

Biden was forced to make concessions but managed to pass the Bipartisan Infrastructure Investment and Jobs Act which contains important climate policy provisions. The $ 1 trillion Infrastructure Act includes several infrastructure modernization measures with important climate policy implications. These range from, for example, the installation of high-speed internet to investments in public transit, high-speed rail and streets and bridges. The bill has passed Congress with broad majorities in both chambers in November 2021. Mandatory requirements for utilities to rapidly increase the share of renewable energy had to be dropped from the bill to ensure passage. The bill contains measures to decarbonize the electricity sector including funding provisions for Carbon Capture and Storage (CCS) technologies for industrial and power sector applications. Some $ 8 billion are earmarked for capture technologies, carbon transport infrastructure and storage facilities as well as hydrogen hubs. Furthermore, the government will invest $7.5 billion in a nationwide electric vehicle charging infrastructure. In addition a grant program was established to promote domestic battery manufacturing.

A new bill with important climate and energy provisions, the Inflation Reduction Act of 2022 (U.S. Senate 2022) was introduced in the Senate in July 2022 and was adopted in August 2022. The bill includes $385 billion in funding and tax incentives for climate and energy programs but also contains support for the fossil fuel industry. The bill, for instance, ensures that the Biden Administration holds more offshore oil lease sales. The support for not only renewable energy but also fossil fuels was key in reaching the necessary votes for the bill in Congress at time when even experts were not expecting any type of climate-relevant legislation anymore.

The Inflation Reduction Act can be considered a milestone in US climate policy. It will help to put the US back on track—yet not all the way—to meeting its Paris Agreement commitment. However, the same legislation could further increase fossil fuel production (Kochrane and Karni 2022). To reach the 2050 target, the US would have to significantly tighten its climate policy, shift to carbon-free energy sources, increase energy efficiency, reduce energy demand and shift consumer behavior (BP 2022a; Mckinsey and Company 2021; U.S. Energy Information Administration 2022i). The political climate in the US, in sum, provides a challenging context for achieving the Biden Administration's ambitious climate targets.

Biden's approach of pursuing much of his climate agenda through executive measures enabled him to circumvent much of the opposition from Congress. His executive powers in the area of climate regulation were, however, curtailed by a July 2022 Supreme Court decision (West Virginia v. EPA) which stipulates that the executive branch cannot regulate coal-fired power plants to the effect of banning coal from the electricity mix without the support of Congress (The White House 2022a). Even before, the president was, however, not completely independent of Congress: Any costs incurred through climate policy measures that are not covered by the Bipartisan Infrastructure Law will require the approval of Congress through the annual budget process. The current political polarization of Congress will make this an additional challenge.

Overall, the Biden Administration's approach shows a few general features. First, the energy and climate policy discourse in the US, also under Biden, is dominated by the principle of national security and energy independence. However, in comparison to his predecessor Donald Trump's 'energy dominance' approach (Mildner et al.

2020), Biden seeks to interlink his energy and climate policy approach. Second, Biden puts green industrial policy at the forefront and combines climate protection with infrastructure modernization and a larger industrial policy strategy. Third, Biden pursues an integrative, whole of government approach. All government departments are required by executive order consider climate protection in all policy decisions made. Moreover, Biden's initiatives take an 'all of America' stance, meaning that climate policy aims to overcome social divides and benefit disadvantaged populations.

3.2.2 The Role of the US States

Next to the federal government, the US states play an important role in advancing climate and sustainable energy policy in the US. They have been spearheading climate policy initiatives and established ambitious policy approaches during the past two decades. For instance, 30 out of 50 states have Renewable Portfolio or Clean Energy Standards. States including Washington, Colorado and Virginia have 100% renewable mandates (Center for Climate and Energy Solutions n.d.).

The recognized leader in terms of progressive climate policy is the state of California, one of the biggest economies worldwide and the second largest CO_2 emitter among the US states. It plans to achieve electricity production based on 100% renewable sources by 2045 (Center for Climate and Energy Solutions n.d.). It will also ban the sale of combustion engine vehicles in 2035 (Newsom 2020). The state is also becoming a central actor in the hydrogen economy, investing largely in production and infrastructure for application in both industry and vehicles (Piria et al. 2021).

Washington and New York have released ambitious policies. Examples include: Washington's 2021 carbon pricing regulation, the Climate Commitment Act, and New York's goal to achieve a carbon free electricity sector by 2045 and carbon neutrality by 2050 (Department of Environmental Conservation n.d.). Next to the traditional climate leader states, some recent newcomers have emerged. North Carolina has set a target of achieving 40% emissions reductions by 2025 compared to 2005 (North Carolina Department of Environmental Quality n.d.). New Mexico, one of the country's largest oil and gas producers, has a new climate target of reducing its emissions by 45% by 2030 (compared to 2005 levels) (Government of New Mexico 2021).

Still, there are still many states lagging without a climate policy in place. Among them is Texas, the largest emitter of CO_2 in the US. Texas is also an example of how ambiguous climate policy can be: It is home to large emission-intensive industries including oil, gas, lignite and chemistry. Yet it is also home to the country's biggest wind and solar energy producer. The state has been experiencing drastically the implications of climate change in recent years with extreme weather events (heat waves, droughts, storms and floods). To date, this has not yet provided an incentive for the state government to implement climate protection measures. Apart from Texas, some Western states, like, Nebraska, Idaho, and Wyoming have shown strong opposition to climate and clean energy policies. Wyoming, the country's biggest coal producer and one of the ten largest oil and gas producers has not implemented any sustainable energy policy, despite having large solar and wind potential. The political focus lies exclusively on the extraction of fossil fuels (Kohler 2021; U.S. Energy Information Administration 2022h). Especially in the climate laggard states, decarbonization efforts to implement the Biden Administration's climate policy plans will mean a transition that starts from scratch, as no policy and regulation is in place and new institutions would have to be set up. The states can thus make an important contribution to achieving climate targets, but a reliance on their activity alone will not generate enough momentum.

3.3 Transatlantic Energy and Climate Policy in Comparison

The US and Germany have much common ground in broader climate and energy objectives, such as their commitments to the Paris Agreement's goals of keeping global warming at 1.5 °C and carbon neutrality by 2045–2050, the increase of renewable and clean energy, as well as the focus on decarbonizing the industrial sector. Overall, both face the challenge of a massive transformation of their economies and societal structures. They must achieve a just transition that takes care of creating jobs, economic growth, and prosperity, while keeping climate change and ecological concerns at bay. However, the US and Germany differ in their pathways for climate and energy policy, which are the result of structural differences that originate in the political system and political traditions, as well as more practical aspects, such as the choice of measures and implementation as well as politics.

In the energy sector, both countries differ in what they perceive as 'clean energy'. In the US, nuclear energy or fossil fuels in combination with CC(U)S are understood as 'clean energy', whereas in Germany the term 'green' is used more frequently and refers generally to renewable energies exclusively. Another notable difference is certainly Germany's decision to phase out both, nuclear and coal as sources of energy (in 2022 and 2038 respectively). There is no such perspective in the US, even though several US states have measures in place to stop the building of new coal mines. In Germany and the EU, carbon pricing has been the instrument of choice since 2005 and is being ex-

panded to further sectors. The US, though originally an advocate for emissions trading, has no such system on the national level, but a few carbon pricing mechanisms exist at the state-level. In Germany, GHG reduction targets are enshrined in national law, in the US there is no central climate law. Instead, the president set most targets via executive orders and some climate provisions are enshrined in the Infrastructure and Jobs Act and the Inflation Reduction Act. In addition, the US has no economy-wide energy efficiency or renewable energy targets.

In Germany, the rise of renewable energies was facilitated through a strong regulative policy; for instance, renewable energies have been given priority when feeding electricity into the grid, and the expansion of electricity generation capacity has been given massive support through the EEG. In the US, overall, the energy sector can be seen as more liberal, in that for example there is more of a technology-open approach. There is an emphasis on market-based approaches and, more recently, on governmental incentives such as green public procurement or regulations regarding public land.

In general, there are significant differences in the political and regulatory framework conditions of the two countries, as Fig. 8 shows. In Germany, the federal government and the EU, and to some degree the subnational level determine the course for energy and climate policy. In the US—in addition to the President, the U.S. states have assumed a powerful position in shaping the country's energy and climate policy framework. In general, Germany is characterized by a high degree of energy and climate policy continuity. Even though the governments of the last two legislative periods have varied in their choice of approaches for climate policy, a general consensus among almost all parties exists agreeing on the need to cut GHG emissions drastically. In the US, climate policy has seen ups and downs, with presidents that ranged from climate change deniers to strong supporters of climate protection.

Another important factor is the support of the population for climate policy. For the vast majority of German society, climate protection is a top priority and Germans are convinced that human activity is the main cause of climate change (Umweltbundesamt 2022c). Also, almost all political parties have taken up climate protection as part of their programs. In contrast, the US population is known for its very divided position on climate change. In a survey in 2020, approximately a quarter of the population believes that climate change does not exist or that no immediate action is required, most of them designating themselves as Republicans (Poushter and Fagan 2020).

In both countries, a high diversity of interest groups shapes energy and climate policymaking. On the one hand, many civil society and environmental movements press for stronger climate actions. And while large companies such as Google, Amazon or Facebook are now committed to emission reductions, especially in the US, there are powerful industrial lobby groups who oppose climate policy such as the U.S. Chamber of Commerce or the National Association of Manufacturers. These groups are well organized, have a long tradition and access to large amounts of financial funding.

4 Transatlantic Relations

The relationship between the US and Germany has a long tradition and includes climate and energy policy: The US is one of Germany's most important sources of oil and coal imports. While the ties experienced several tensions under former president Donald Trump, with Biden's presidency, transatlantic relations have experienced a push and entered into a new phase of cooperation. Germany and the EU enter this new phase with an increased interest in energy security and in reducing dependence on energy imports from Russia. The Biden administration has expressed its interest in lessening the European countries' dependence on Russia, as well. Moreover, it is interested in fostering the transatlantic relationship to counterbalance China, for instance with respect to its market leadership in low-carbon technologies.

Cooperation in the industrial and technological sectors and in the parallel the improvement of trade relations provide a good starting point for strong transatlantic relations. Several alliances were revoked or launched for this purpose, for instance:

In May 2022, ministers from both countries concluded a joint declaration for a *U.S.-Germany Climate and Energy Partnership*. It identifies three key areas of collaboration; (1) accelerating climate action to ensure a net-zero future; (2) developing and deploying technologies to speed the energy transition; and (3) promoting ambitious climate policies and energy security in third countries (Bundesministerium für Wirtschaft and Klimaschutz 2022).

On the EU level, further alliances are the Transatlantic Green Trade Agenda of December 2020, intending to jointly take measures against carbon leakage, the migration of companies to countries with lower climate standards (European Commission 2020a). The EU-U.S. Trade and Technology Council (TTC) is intended to deepen transatlantic trade and economic relations, for example through joint action on export controls including climate and clean technology (Koch 2021). The EU and the US have further established a Joint Technology Competition Policy Dialogue to strengthen transatlantic cooperation on policies regarding competition in the technology sector. Most notable are the Joint *US-EU Statement on Trade in Steel and Aluminum* and the *Global Methane Pledge*, launched by the US and at the UNFCCC COP26 in Glasgow.

Both, Germany, and the US have included clean hydrogen as a central element of their decarbonization plans (European Commission 2020b; U.S. Department of Energy n.d.). They seek to make it available in large amounts as cheaply as possible by 2030. Promising areas to deepen transatlantic cooperation and dialogue in this field are research and development, the measurement and certification of the greenhouse gas intensity of hydrogen supplies, infrastructure development and international hydrogen supply chains, and possibly the development of international sustainability standards for hydrogen. Since 2021, the EU and the U.S. have already been working internationally with other partners in the *Mission Innovation 2.0 initiative*, to increase research and development in the field of clean hydrogen. Also, under the roof of the German G7 presidency in 2022, a Hydrogen Action Pact has been launched, which can be the start of a multilateral cooperation, but where the US and Germany can play key roles (Bundesregierung Deutschland 2022b).

Energy security moved to the top of the political agenda in Germany and the EU in the first months of 2022 when the war in Ukraine started. Germany has been seeking to secure alternatives to gas imports from Russia. In this context, the German government has intensified its dialogue with the US which could supply liquefied natural gas to Germany, as the country builds up the necessary import infrastructure. The European Commission and the US government have set up the joint Task Force on European Energy Security to help reduce fossil fuel demand and diversify energy suppliers in the EU. In this context, the US has also increased its LNG exports to the EU substantially and the Biden Administration has already communicated its willingness to increase them further and at the same time introduce measures to limit methane emissions from natural gas production (The White House 2022b). While this increased LNG cooperation would deepen transatlantic energy ties, the necessary increases in US natural gas production in the US would certainly make it more difficult for the US to achieve its 2030 goals. For the climate, such enhanced cooperation is therefore not beneficial.

Another opportunity for intensified transatlantic cooperation is the climate club proposed by Germany under the G7 and scheduled to be launched by the end of 2022 (Bundesregierung Deutschland 2022b). This initiative, aimed at complementing the Paris Agreement's goals of achieving carbon neutrality by mid-century, might become a new forum for pushing the decarbonization of the industrial sectors of the transatlantic partners. It will focus on increasing comparability, finding common metrics and standards for industry in relevant areas, which could include steel, clean hydrogen, carbon pricing and sustainable supply chains. The climate club thereby might help to overcome existing barriers and tensions that exist concerning the expected impacts of climate policy measures or even controversial measures such as the Carbon Border Tax Mechanism (CBAM) as proposed by the EU. The US has regarded the proposed CBAM with skepticism as it would raise the costs for exports to the EU through a fee on carbon emissions.

5 Outlook and Conclusions

In sum, the above discussions of energy systems and climate and energy policies in Germany and the US highlight that a transformation of the decarbonization of the energy supply is progressing—albeit slowly considering the ambitious goals both countries have set for 2030 and the mid-century. In the US, this development is, at least under the current presidential administration, driven by the executive and the US states, by technological progress and from the demand-side. In Germany, it is also driven by binding sector-specific decarbonization goals and specific technological requirements. The US is, however, not only a clean energy leader. Its importance as a fossil fuel producer and exporter has also been growing. The USA and Germany are pioneers in innovation in system solutions for renewable energies and in the area of mobility. For the US, its relationship with Germany and other countries in this context is also important in building a counterweight to China which has assumed market and technological leadership in clean technologies. Climate protection remains very high on the agenda in Germany and now again in the US.

In the current political situation, the transatlantic relationship has grown in importance, once again. But its role in achieving sustainability transformations across the Atlantic has, at the same time, become more ambivalent. On the one hand, the transatlantic partners are seizing many existing formats and creating new cooperation formats to push topics, which are of great importance for national and global climate protection agendas. They are cooperating, for instance, on clean hydrogen, batteries and green steel through research and development efforts and trade agreements, to promote green technologies and reduce the carbon intensity of supply chains. Moreover, they have put the reduction of methane emissions, a neglected climate topic, back on the global political agenda.

On the other hand, the US has become an important building block of the EU's strategy to diversify its natural gas suppliers. For this purpose, the US is working to increase its natural gas production capacities to enable increased exports to the EU. Transatlantic climate and energy relations under the Biden Administration and the Scholz Chancellorship have thus deepened both in terms of green energy and technology and fossil fuels. Ensuing increases in US natural gas production, however, run counter to global climate goals of phasing down fossil fuel production and

steering investments away from fossil fuels and towards green technologies.

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